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RESEARCH MEMORANDUM

DETERMINING CONTINUATION RATES FOR PILOTS FROM THE OFFICER MASTER FILE

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This research memorandum examines how the definition of the continuation rate for Naval officers is implemented using data from the Officer Master File. Continuation rates are measured for a cohort of officers defined by their designator and year group. Several conceptual and data problems arise because the simple definition of the continuation rate does not account for various inflows and outflows for specific cohorts. The effect of including or excluding various subgroups within a cohort is considered using pilots from year groups 73 through 78 for the period from 1980 through 1986.

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1. Enclosure (1) is forwarded as a matter of possible interest.

2. The Officer Master File (OMF) is the source used to measure continuation rates of officers in the Navy. In this research memorandum, the OMFs from 1981 through 1987 are joined together to create a longitudinal file to track individual pilots over time. This longitudinal file is used to reconcile year-to-year changes in year-group size and to determine the magnitudes of various sources of year-group inflows and outflows. From this analysis, continuation rates based on different inflows and outflows are calculated and compared.

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DETERMINING CONTINUATION RATES FOR PILOTS FROM THE OFFICER MASTER FILE

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ABSTRACT

This research memorandum examines how the definition of the continuation rate for Naval officers is implemented using data from the Officer Master File. Continuation rates are measured for a cohort of officers defined by their designator and year group. Several conceptual and data problems arise because the simple definition of the continuation rate does not account for various inflows and outflows for specific cohorts. The effect of including or excluding various subgroups within a cohort is considered using pilots from year groups 73 through 78 for the period from 1980 through 1986.

EXECUTIVE SUMMARY

Continuation rates influence policy in a number of important areas, including recruiting, training requirements, compensation policies, and the allocation of officers by designators or other grouping. Because of their widespread usefulness, having accurate measures of continuation rates is vital to policymakers and planners. The continuation rate for a group of officers is the percent of a cohort remaining in the Navy over a given period. Although the definition of the continuation rate is straightforward, implementing this definition on data poses a number of problems. These problems arise because the simple definition of the continuation rate does not anticipate flows of officers into and out of cohorts. Depending on how the various flows are treated, the continuation rate can vary over a wide range.

In calculating continuation rates, officers are typically sorted by designators and year groups. This research memorandum investigates the continuation rate of pilots in year groups 73 through 78. The continuation rate, C_t, is generally defined as the ratio of the inventory in a cohort at the end of a period, A_t, divided by the inventory at the beginning of the period, N_t:

$$C_t = \frac{A_t}{N_t} .$$

Difficulties arise because this simple definition does not give any guidance on which officers to count in the ending inventory. The outflow of officers from a cohort has three components:

- *Attritions*—those leaving the Navy
- *Lateral outs*—those changing from a pilot designator to a nonpilot designator, such as from 131x to 119x
- *Year-group (YG) outs*—those changing to a new year group.

Officers leaving a cohort may not necessarily leave the Navy or even the pilot community. Different continuation rates could be calculated taking into

account these different outflows, and different rates would be appropriate for different applications.

The problem of measuring continuation rates is further complicated by the existence of various cohort inflows. Three inflows are identified:

- *Lateral ins*—those who make lateral transfers from a nonpilot designator to a pilot designator, such as from 111x to 139x
- *Accessions*—those not on active duty the previous year, usually an interservice transfer (from the Marine Corps) or returning to active duty
- *Year-group (YG) ins*—those changing from another year group (possibly listed as a blank previously).

The problem with inflows is that gross and net continuation rates differ. When there are inflows, the ending inventory in one year does not correspond to the beginning inventory in the following year. In this case, the continuation rate based on the gross flow is lower than the rate based on the net flow. Using continuation rates based on the gross flow tends to exaggerate attrition.

The inflows and outflows to and from cohorts are referred to as turbulence. As the amount of turbulence in the data increases, the divergence between various measures of the continuation rate increases. Figure I illustrates the various sources of turbulence for year group 73 pilots between 1980 and 1984. The inventory at the start of 1980 was 355, and the inventory at the end of 1980 was 317. In this case, the gross continuation rate is 89.3. Of the 317 pilots at the end of the year, one had changed year groups, so that the gross rate after the year-group change was 89.0 (316/355). However, the inventory at the start of 1981 is 350.[1] The difference between the 317 and the 350 is the inflow of 34 pilots from various

1. The ending inventory for 1980 and the starting inventory for 1981 are taken from the same copy of the Officer Master File (OMF). The difference between the two is that the 317 all match the original group of 355, whereas the 350 is the total number of pilots on the OMF tape.

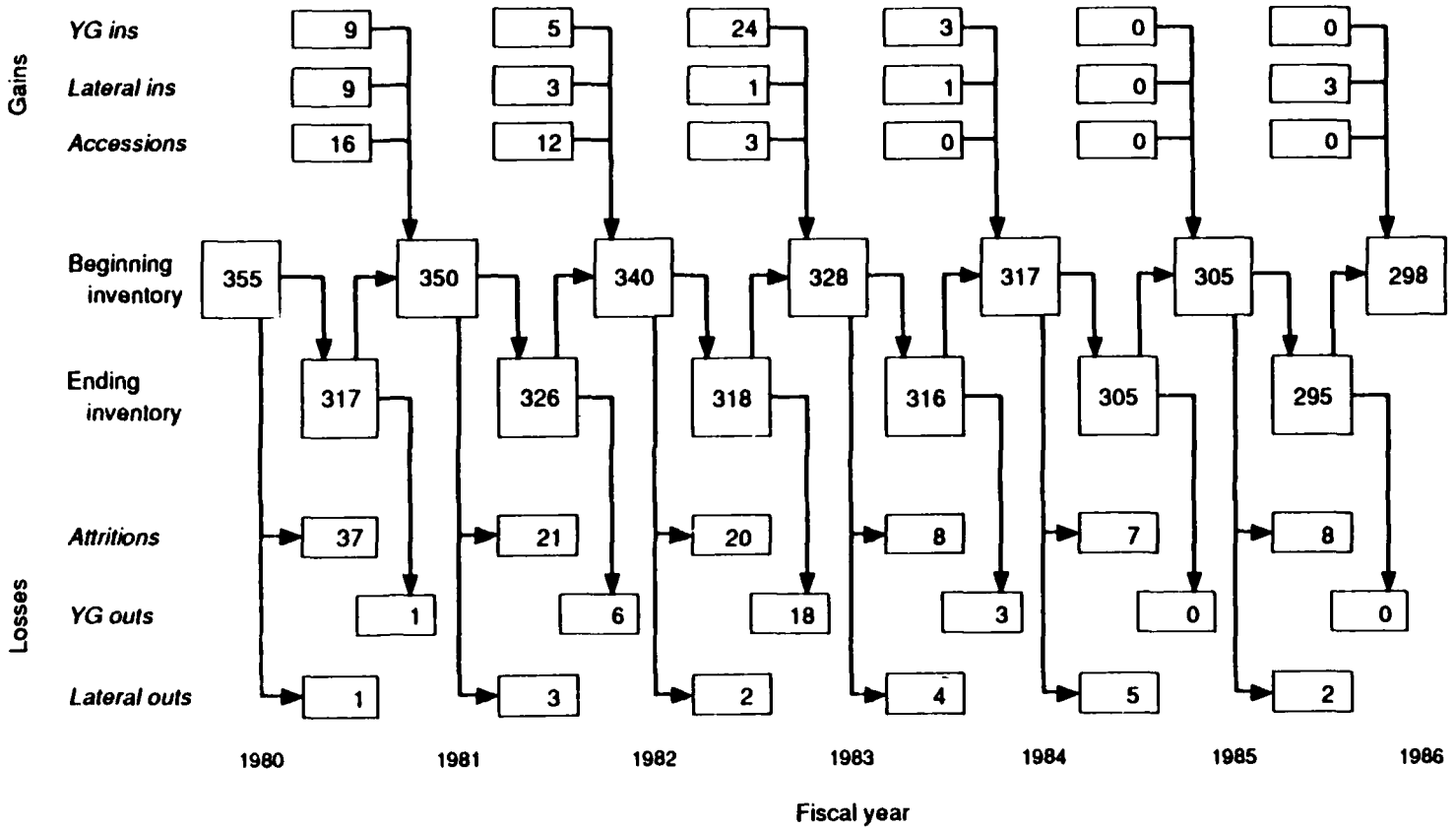

FIG. I: YEAR GROUP 73 PILOTS (131x AND 139x), FY 1980 THROUGH FY 1986

sources and the further outflow (through a year-group change) of one additional pilot. The net continuation rate is 98.6 (350/355). This variation in the continuation rates in just one year illustrates the scope of the problem.

Table I shows four different measures of continuation rates for pilots in year groups (YGs) 73 through 78 between 1980 and 1986. The third column in the table shows the change in the total strength, which is the net continuation rate. The fourth and fifth columns show the gross continuation rates; the difference is that the second rate includes year-group attrition and the third rate excludes year-group attrition. The last column shows the actual continuation rate of the starting cohort in 1980.

TABLE I

ALTERNATIVE CONTINUATION RATES FOR PILOTS IN YEAR GROUPS 73 THROUGH 78

Year group	YOSs[a] covered	Definition of continuation rate: Total strength	Gross w/o *YG outs*	Gross w *YG outs*	Original total
73	7-13	83.9	63.7	69.6	71.6
74	6-12	62.1	51.7	52.9	54.7
75	5-11	43.9	37.8	40.8	41.4
76	4-10	52.2	42.1	43.8	43.3
77	3-9	49.5	44.6	45.0	44.3
78	2-8	44.8	41.6	41.7	41.3

a. YOS is years of service.

The effect of the choice of continuation rate differs considerably across year groups. The differences tend to be larger for the earlier year groups (in particular, 73 and 74) than the later year groups in the series. Also, in comparing the four definitions of continuation, the difference between the total strength and other definitions is larger than the differences among the other definitions. The differences could be caused by the timing of the observations—that is, the amount of turbulence varies over the years, as well as the experience levels of the year groups. Each year group is tracked over a different set of years.

The variation in these continuation rates across year groups and methodologies illustrates the importance of the problem of clearly defining the continuation rate appropriate for a particular situation. Gross continuation rates are uniformly lower than the net continuation rates by at least 5 percent, and in some cases considerably more. Planners and policymakers need to be aware of these differences and to apply the appropriate rates to each situation.

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INTRODUCTION

Continuation rates influence policy in a number of important areas, including recruiting, training requirements, compensation policies, and the allocation of officers by designators or other grouping. Because of their widespread usefulness, having accurate measures of continuation rates is vital to policymakers and planners. The continuation rate for a group of officers is the percent of a cohort remaining in the Navy over a given period. Although the definition of the continuation rate is straightforward, implementing this definition on data poses a number of problems. These problems arise because the simple definition of the continuation rate does not anticipate flows of officers into and out of cohorts. Depending on how the various flows are treated, the continuation rate can vary over a wide range.

The data source for the analysis in this paper is from the Officer Master File (OMF). The OMF is a file of all officers on active duty at a point in time, usually 30 September—the last day of the fiscal year. The OMF is a primary source of information about individual officers on active duty and has been used by community managers, strength planners, and other groups within the Navy to determine continuation rates. The study uses annual extracts from the OMF from 1980 through 1986.

This memorandum deals specifically with continuation rates for Navy pilots. Although conceptual and data problems arise in defining continuation for the entire officer corps, some problems are realized with smaller cohorts. In particular, because of transfers among communities in the Navy, problems arise in determining continuation for each community. Pilots are a particularly useful community to study because policymakers confront the whole gamut of officer issues within the pilot community. The Navy invests a substantial amount of time and money in training each pilot, and the pilot training rate depends on continuation rates over time. A large percentage of billets filled by pilots can be filled only by pilots, so that a sufficient number of pilots are required at different career points to meet requirements. Lateral transfers are fairly common out of the pilot community, and as the data below show, in some years it is also significant into the

community. Accurate information about historical continuation rates can be useful in planning how many pilots to train, how many pilots to retain at different career points, and how large a bonus to offer.

DEFINING THE CONTINUATION RATE

Theoretically, calculating continuation rates from the OMF should not be difficult. The continuation rate for a cohort of pilots is defined as the number of pilots in the cohort at the beginning of a period divided by the number of officers in that cohort at the end of the period. The continuation rate in year t (C_t) can be formally defined[1] as

$$C_t = \frac{A_t}{N} , \tag{1}$$

where N is the starting inventory and A_t is the number officers on active duty at time t. This definition is usually applied to the continuation of a year group of officers from year to year. In this case, N is the inventory at the beginning of the year, and A_t is the inventory at the end of the year. The difference between A_t and N is supposed to be just attrition. The two major sources of attrition for pilots are lateral transfers—that is, officers who change to nonpilot designators—and active-duty attritions—that is, officers who leave the Navy. Attrition from pilot to nonpilot designators is directly observed on the OMFs because these files include fields for designator changes. Navy attrition is observed only indirectly by absences from the Officer Master File in the subsequent year.[2]

Conceptual issues arise with this definition because there are a number of sources of inventory changes besides attrition. These flows cause a kind of turbulence in the data. Some officers move into and out of a cohort. Because of this turbulence, there is not always the smooth outflow of inventory anticipated in the simple definition of the continuation rate. Tracking the various flows is crucial to understanding the challenge of measuring continuation rates.

1. This definition is from Navy Military Personnel Command, *Continuation Data and Rates for Officers*, 5314 Ser N1654H/107SA, 9 May 1985. It is a standard definition in Navy Manpower circles.

2. In some cases, officers who have left the Navy appear on the Inactive Officer Master File.

Year-Group Flows

The various sources of turbulence in the data can be illustrated by considering the four components of the ending inventory: *lateral ins (i), intras (n), accessions (a), and unchanged (u).*

$$A_t = i_t + n_t + a_t + u_t \quad . \tag{2}$$

The *lateral ins* include all officers who have changed from a nonpilot to a pilot designator in the last year. The pilot designators are: 131x, a Line Officer qualified for duty involving flying as a pilot; 139x, a Line Officer in training for duty involving flying as a pilot; and 123x, a Line Officer who is a Materiel Professional designated and qualified for duty involving flying as a pilot.[1] The *lateral ins* group could include both lateral transfers from other communities and a change in the designator from 130x to 131x, which indicates a trained pilot has regained his flight qualification. *Intras* are those that have changed designator within the pilot community in the last year. These changes are most likely to be from 139x to 131x, 131x to 123x, or xxx5 to xxx0. (The latter change indicates an augmentation from a reserve commission to a regular commission.) The *accessions* are officers who were not on active duty the previous year; they include both Navy pilots returning to active duty and lateral transfers from other services. The *unchanged* group includes officers who have not changed their designator in the last year.

Only the *intras* and *unchanged* groups are in both the beginning and ending inventories. If the number of *lateral ins* and *accessions* (that is, the inflow) exceeds the number of *lateral outs* and *attritions* (the outflow), the continuation rate exceeds 100 percent.[2]

1. The Materiel Professional (MP) designator was instituted in 1986. The MP designation is for officers in the grade commander and above. None of the officers in year group 73 had an MP designation in 1986.

2. For the pilot community, the total outflow generally exceeds the inflow; however, there are instances when this is not the case.

There are several approaches, each with its own strengths and weaknesses, that can be taken in dealing with the inflow. The first approach is to ignore the inflow altogether—that is, only include *intras* and *unchanged* in the final inventory:

$$C_t = \frac{n_t + u_t}{N} \quad . \tag{3}$$

This approach might be justified if inflowing pilots do not have the same level of experience as the pilots already in the year group and therefore should not be part of the cohort. Even though this is a reasonable argument, there are problems. If inflowing pilots are not classified with their year group, they must be counted with some other year group. Then a practical problem arises of how to keep track of which pilots should be included in which cohort. Given that inflows are likely to represent a small number in a given year, it is unlikely that excluding them will have a significant effect on the continuation rate for a particular year. However, even if the effect is small in a given year, the cumulative effect over a group of years, such as 6 to 11 years of service, could be quite substantial. Cumulative continuation rates are usually calculated by multiplying together the continuation rates for individual years. A small error in each year compounds into a large error for a series of years.

Excluding inflowing officers in one year poses a further problem in calculating continuation rates in subsequent years. If the inflowing officers are ignored in one year (i.e., equation 2), then the continuation rate in the next year could be defined in two ways:

$$C_{t+1} = \frac{n_{t+1} + u_{t+1}}{n_t + u_t} \quad , \tag{4}$$

or

$$C_{t+1} = \frac{n_{t+1} + u_{t+1}}{n_t + u_t + i_t + a_t} \quad . \tag{5}$$

Excluding inflowing officers from all calculations (i.e., equation 3) may provide an accurate measure of the survival of a particular subgroup within the pilot community, but it does not accurately reflect total pilot endstrength.

However, if inflowing officers are excluded from the numerator only in the year that they enter the pilot community (equation 4), it is inconsistent to include them in the starting inventory in subsequent years.

Although equation 4 clearly involves the inconsistent treatment of officers over time, it can easily find its way into the calculation of continuation rates. The problem is that in the OMF it is difficult to track inflowing officers from year to year. For example, a pilot who is an *accession* in 1981 appears like any other officer in 1982 and beyond. Unless the analyst is aware of the problem and makes a special effort to track inflowing officers[1] and to exclude them in subsequent years, these officers are counted.

An alternative approach to the one described above is to include the *accessions* and the *lateral ins*:

$$C_{t+1} = \frac{n_{t+1} + u_{t+1} + i_{t+1} + a_{t+1}}{n_t + u_t + i_t + a_t}. \quad (6)$$

In this case, the total strength is included in determining continuation rates. Given that planners and policymakers are generally interested in the total number of pilots available at a given experience level rather than the identity of particular pilots, this approach is more appropriate for some cases. For example, one of the keys in determining the pilot training rate is knowing the number of pilots available to fill certain billets at different phases of officers' careers. Because inflowing pilots are capable of filling these billets, they should be counted in the inventory. However, this approach may be inappropriate for studying such questions as the effect of bonuses because a different population may be eligible for the bonuses than are included in the continuation rates.

1. *Lateral ins* could be identified using the designator history. *Accessions* could be identified by using the current active duty start date.

Year-Group Changes

One further conceptual problem is the question of year-group changes. The main reason for a change in year group is out-of-zone promotions. Officers receiving below-zone promotions are changed to an earlier year group, and those receiving above-zone promotions are changed to a later year group. Year-group changes cause both inflows and outflows from a particular year group as long as there are out-of-zone promotions in each year group.

Although year-group changes do not affect the overall size of the community, they could affect the observed continuation rate. Also, even though the net flow of year-group changes (i.e., inflows minus outflows) is likely to be small for each year group, the different timing of inflows and outflows will change the continuation rates for each year.

Year-group changes pose some of the same choices in defining the continuation rate as other inflows or outflows. There may be some circumstances when they should be included and others when they should be excluded. However, exclusion of year-group changes means that outflowing officers cannot be counted as attrition. The main justification for excluding *lateral ins* or *accessions* is that they may have a different level of actual expertise and experience than the rest of the year group. In this case, year group changes are made because the officers changing year groups are deemed to have the same level of expertise and experience as their new year group. Thus, the case for excluding year-group changes is weaker than that for excluding *accessions* and *lateral ins*.

To account for year-group changes, equation 2 can be rewritten to include year-group inflows, *yi*:

$$A_t = i_t + n_t + a_t + u_t + yi_t, \qquad (7)$$

and equations 3 through 5 can be modified for these new flows as appropriate. Furthermore, the outflow from a year group could be considered a third source of attrition besides *lateral outs* and *attritions*.

Conceptual differences in the alternative definitions that were pointed out suggest that different continuation rates may be appropriate for different purposes. The policymaker or analyst must decide which definition is appropriate. A question that arises is how important is the choice of a given definition–that is, in practice, how much do the measures of continuation vary and is it enough to warrant concern over inappropriate applications of various measures. Answers to these questions are empirical. In the next section, analysis is presented to shed light on these issues.

EFFECT ON CONTINUATION-RATE CALCULATIONS

This section illustrates how continuation rates are affected by including or excluding the inflowing officers. The illustration uses data for year group 73 pilots[1] from the OMF for 1980 through 1986. Active duty officers are identified as having a blank Gain/Loss indicator code (field 186 of the OMF). From this population, officers with designators indicating a Training and Administration of Reserves (TARs) are excluded. TARs are excluded because they are not counted toward active endstrength. In addition, TARs have different community managers from officers with regular or reserve commissions.

The inventory for each year is determined by counting the number active duty officers with pilot designators (i.e., 139x, 131x, or 123x) in year group 73, the end fiscal year (30 September) OMF. These inventory counts, which are shown in the first line of table 1, include all five components of equation 7, *lateral ins*, *intras*, *accessions*, *unchanged*, and *year-group ins*.

Table 1 decomposes the total inventory into its five components. Determining the number of *lateral ins* and *intras* from the OMFs is straightforward. In both cases, the designator history (fields 505 through 520 of the OMF) are used to identify pilots with a changed designator in the past year. If the previous designator was a nonpilot designator the officer is counted as a *lateral in*, and if it was a pilot designator, he is counted as an *intra*.

Separating the *accessions* from the *unchanged* is more difficult. There are two possible methods. One, is to check whether the current active duty start date of the remaining officers (i.e., not otherwise classified as a *lateral in* or an *intra*) is within the last year. If it is, the officer is classified as an *accession*, otherwise he is an *unchanged*. Alternatively, records of officers

1. This analysis includes officers with designators 131x, 139x, and 121x. Data for officers with designator 131x only are reported in appendix A. There is much greater turbulence for 131xs, particularly for the later year groups, because there are a lot of designator changes from 139 to 131. In the main text, these changes are *intras*, but in the appendix they are treated as *lateral ins*.

can be matched with the previous OMF. If the officer was not on active duty in the previous OMF, he is classified as an *accession;* otherwise he is an *unchanged.* This latter method was used in this analysis because matching is required to identify year-group changes.

TABLE 1

COMPOSITION OF YEAR GROUP 73:
FY 1980 THROUGH FY 1986

	Fiscal year						
Category	1980	1981	1982	1983	1984	1985	1986
Total	355	350	340	328	317	305	298
Lateral ins	5	9	3	1	1	0	3
Intras	12	7	9	8	2	4	4
Accessions	-	16	12	3	0	0	0
Unchanged	335[a]	306	311	292	311	301	291
Year-group ins	-	9	5	24	3	0	0
Cont. of original total	355	325	290	271	267	260	255

a Includes *accessions* and *year-group ins.*

Matching records across contiguous OMFs is needed to identify year-group changes because there is no field on the OMF that identifies such changes. In the absence of such a field, it may be impossible to get an accurate measure of continuation rates for a year-group from a single OMF. Year-group changes can be noted by comparing the year group on the records across years.

The final line of table 1 shows continuation history of the original 355 pilots in year group 73 that were on the 1980 OMF. This group includes only those pilots that were identified as either an *intra* or an *unchanged.* Continuation rates based on this count exclude inflowing officers from the numerator of the year of entry into the community and both the numerators and denominators of subsequent years.

Table 1 indicates that most of the inflow into year group 73 occurred between 1980 and 1983 or between the seventh and tenth years of service.

Beyond the tenth year of service, the core of the year group was relatively stable. Because this particular analysis starts with a year group in its seventh year of service, it is not possible to discern the amount of inflow before the seventh year. Analysis for other year groups in a subsequent section of this paper provides information on this question.

Table 2 shows the breakdown of attrition from year group 73. Most of the attrition occurs within the first three years, and most of the year-group attrition is attrition from the Navy. The number of lateral transfers at this stage of the pilots' careers is relatively small.[1] The peak of the outflow of year-group changes occurs one year before the peak of the inflow shown in table 1. Also, for this year group, there is a net inflow of year-group changes.[2] The current data set could not trace the attrition from 1986 because it requires information from the 1987 OMF. Consequently, the 1986 attrition breakdowns are blank.

TABLE 2

COMPOSITION OF ATTRITION FROM YEAR GROUP 73: FY 1980 THROUGH FY 1986

	Fiscal year						
Category	1980	1981	1982	1983	1984	1985	1986
Total	39	30	40	15	12	10	-
Lateral outs	1	3	2	4	5	2	-
Attritions	37	21	20	8	7	8	-
Year-group outs	1	6	18	3	0	0	-

The information on inflows and outflows from tables 1 and 2 can be used to reconcile the changes in the total year-group size. Figure 1 depicts the flow of pilots in year group 73. The beginning and ending inventories are given in the two rows of boxes in the center. The inventory gains or inflows consist of the *year group ins*, *lateral ins*, and *accessions* and are

1. There is probably a significant number of lateral transfers in the first few years of service.
2. The net inflow of year-group changes in this case may be due to its relatively small size. With a small year-group inventory, opportunities for early promotion in later year groups may be enhanced.

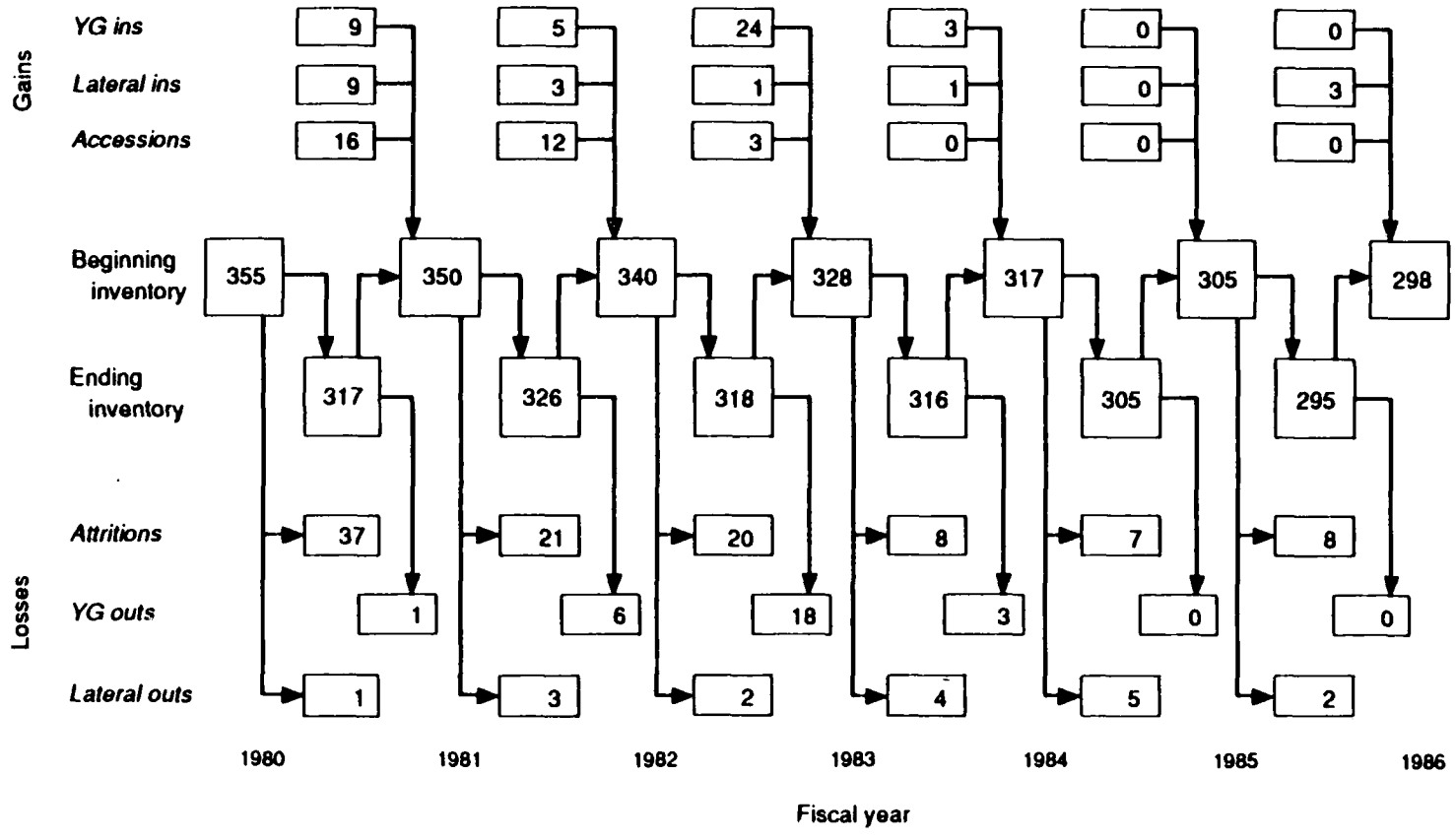

FIG. 1: YEAR GROUP 73 PILOTS (131x AND 139x), FY 1980 THROUGH FY 1986

given at the top of the figure. The losses or outflows, depicted flowing out of the beginning inventory in the bottom portion of the figure, comprise *attritions, year-group outs* and *lateral outs.* Note that the net change in the year-group size does not necessarily reflect the changes that occurred in the year group. For example, in 1980 there were 355 pilots in the year group, and in 1981 the number was 350. The decrease of 5 was the net result of an inflow of 34 officers and an outflow of 39 officers The small net change between 1980 and 1981 masks a significant amount of turbulence. Even though the size of the year group changed only by 5, the composition changed by more than 10 percent. The amount of turbulence declines sharply near the end of the period studied, but there is no clear relationship between the amount of turbulence and the net flow.

Table 3 uses the information in table 1 to calculate a series of alternative measures of continuation rates. This table shows both the annual continuation rates and the cumulative continuation rates over the entire period.

TABLE 3

ALTERNATIVE CONTINUATION RATES
FOR YEAR GROUP 73: FY 1980 THROUGH FY 1986

	Fiscal year						
Description	1981	1982	1983	1984	1985	1986	CCR[a]
Total strength	98.6	97.1	96.5	96.6	96.2	97.7	83.9
Gross cont. w/o *YG outs*	89.0	91.4	88.2	95.4	96.2	96.7	63.7
Gross cont. w *YG outs*	89.3	93.1	93.5	96.3	96.2	96.7	69.6
Original total	88.1	92.6	93.4	98.5	97.3	98.0	71.6

a. CCR is the cumulative continuation rate.

The first row of continuation rates is derived from the top row of table 1 and is based on equation 5. These figures include everyone in the OMF in the year group in each year. The second row shows the percent of the inventory in the year group at the end of the year that was there in the beginning of the year. These figures are derived from equation 4, but are modified to take into account the outflow from year-group changes. From

figure 1, these numbers are essentially the ratio of the ending inventory less the *year-group outs* to the beginning inventory numbers. The third row is a slight variation on the second. It includes the *year-group outs* in the numerator. The fourth row is derived from equation 3. These figures are calculated from the last line of table 1, which follows the original 355 officers in year 73 from 1980 through 1986.

The last column of table 3 shows the cumulative continuation rates between 1980 and 1986. The four methods of calculation produce differences in the cumulative continuation rates. The net continuation rate, which includes the inflow in the numerator, as shown in the first row, is one-third higher than the gross rates, which excludes the inflow. The second method measures the gross continuation rate. Although this method captures continuation in any one year, it underestimates cumulative continuation. If the cumulative rate of 63.7 percent is applied to the original 355 pilots, it implies that 226 pilots would be around in 1986. The actual number was 255, which is a difference in the inventory of over 10 percent. If inflowing officers are included in the final inventory, the second method underestimates the final 1986 inventory by nearly 30 percent.

This section illustrated some conceptual problems in measuring continuation rates. The main focus of these problems is the treatment of officers that flow into a community. Both individual year and cumulative continuation rates are sensitive to assumptions made about inflowing officers. Given the sensitivity of continuation rates to these assumptions, it is necessary to select the appropriate definition for each specific task or policy question.

The continuation rates shown in table 3 are for illustrative purposes. In addition to these conceptual problems in defining the continuation rates, there are some data problems as well with the Officer Master Files. These problems are discussed in the next section.

DATA PROBLEMS

Even if policymaker can identify the correct conceptual definition for continuation rates, there is another set of data issues that must be considered. Like most large data sets that must be updated over time, the OMFs contain errors. Some of these errors have implications for tracking the flows of officers into and out of a year group. This section discusses two sources of errors that affect the calculation of the continuation rates.

On some officer records, the year-group field goes blank or has an invalid number, such as 00,[1] for one or more years. On the tape for some other year, the year-group field is filled in. This problem is a pure data problem that can circumvented by handling the data more carefully.

Year-group miscoding affects a relatively small number of cases. In the 1973 year-group data set constructed for this study, about 10 percent of the records either have a change in year group or are missing a year group at some time. The bias caused by ignoring or miscoding these cases is likely to be small in any one year, but it could be significant on the cumulative continuation rate.

Table 4 shows the magnitude of the year-group problem for the year group 73 data set. It shows the number of records in each year with year groups other than 73. The effect of including the blank year group observations is to decrease the cumulative continuation rate to 80.7 percent, which is still quite a bit higher than the other calculations.

Another problem with the data is that the dates for designator changes are not always updated. In examining matched records from the OMF, there are some cases in which the designator has changed in the last year, but the date does not reflect this recent change. This problem is relatively minor, but it could lead to misclassifying some officers as *unchanged* when they actually belong in another category.

1. The year group 00 may be valid in some communities, but not among pilots. When new medical officers are accessed into the Navy, they start with an 00 year group for some period before being assigned to a year group.

TABLE 4

NUMBER OF PILOTS IN YEAR GROUP 73
AS SHOWN ON ANNUAL OMFS

	Fiscal year						
Category	1980	1981	1982	1983	1984	1985	1986
YG 73	355	350	340	328	317	305	298
Other[a]	17	14	12	1	0	0	2
Total	372	364	342	329	317	305	300
Continuation rate	-	.978	.967	.935	.964	.962	.984

a. Includes blanks.

INTER-YEAR-GROUP COMPARISONS

The discussion thus far has focused narrowly on a single year. This section expands the analysis to include the five succeeding cohorts to year group 73. The purpose of expanding the analysis is to provide some comparison to determine the significance of the various inflows and outflows. Table 5 reports cumulative continuation rates for year groups 73 through 78 using the definitions from table 3.

TABLE 5

ALTERNATIVE CONTINUATION RATES
FOR YEAR GROUPS 73 THROUGH 78

		Definition of continuation rate			
Year group	YOSs[a] covered	Total strength	Gross w/o *YG outs*	Gross w *YG outs*	Original total
73	7-13	83.9	63.7	69.6	71.6
74	6-12	62.1	51.7	52.9	54.7
75	5-11	43.9	37.8	40.8	41.4
76	4-10	52.2	42.1	43.8	43.3
77	3-9	49.5	44.6	45.0	44.3
78	2-8	44.8	41.6	41.7	41.3

a. YOS is years of service.

The effect of the choice of continuation rate differs considerably across year groups. The differences tend to be larger for the earlier year groups (in particular, 73 and 74) than the later year groups in the series. Also, in comparing the four definitions of continuation, the difference between the total strength and other definitions is larger than the differences among the other definitions. The differences could be caused by the timing of the observations—that is, the amount of turbulence varies over the years, as well as over the experience levels of the year groups. Each year group is tracked over a different set of years.

Additional information on differences in the continuation rates can be determined by examining the turbulence in the data. In particular, the composition of the inflow can reveal the source of turbulence. Table 6 shows

the annual flow in three of the key categories: *lateral ins*, *accessions*, and *year-group ins*. These three categories are the major source of turbulence and so the major cause of problems in measuring continuation rates. Figure 2 depicts the total (all year groups) annual flow of pilots in each category.

TABLE 6

LATERAL INS, ACCESSIONS, AND *YEAR-GROUP INS* FOR YEAR GROUPS 73 THROUGH 78

	OMF year					
Year group	1981	1982	1983	1984	1985	1986
			Ins			
73	9	3	1	1	0	3
74	12	7	3	0	0	0
75	7	8	4	1	0	0
76	16	17	6	3	2	3
77	9	23	11	4	2	4
78	8	15	8	2	2	1
Total	61	73	33	11	6	11
			Accessions			
73	16	12	3	0	0	0
74	10	10	2	0	0	0
75	8	6	10	0	1	0
76	9	5	6	0	0	1
77	5	5	6	0	1	0
78	3	2	3	0	0	2
Total	51	40	30	0	2	3
			Year-group ins			
73	9	5	24	3	0	0
74	3	2	25	5	3	0
75	3	10	4	7	1	0
76	2	5	16	0	5	10
77	2	0	3	0	0	1
78	3	2	1	0	0	1
Total	22	24	73	15	9	12

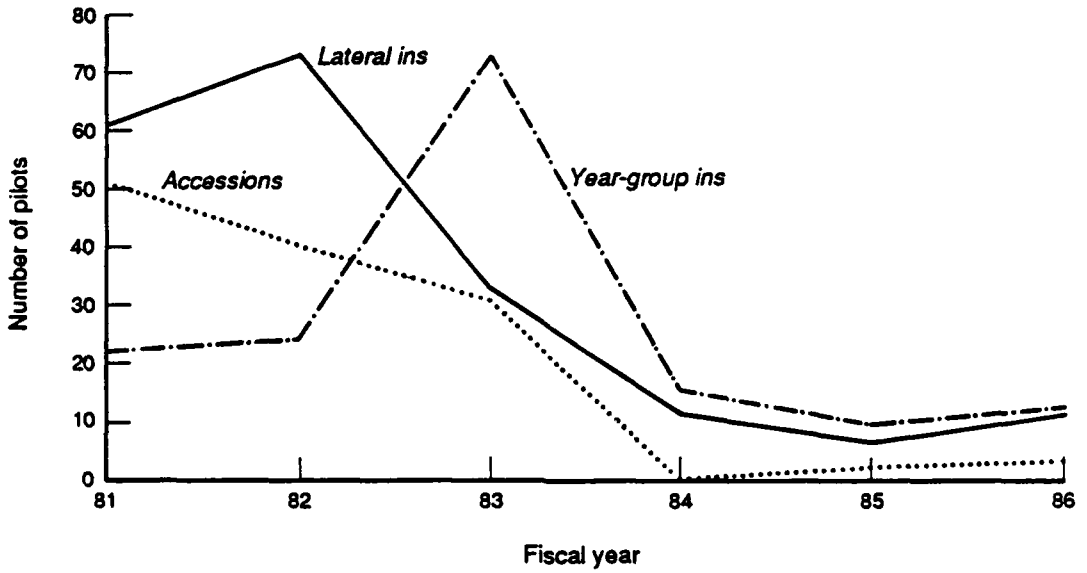

FIG. 2: COMPOSTION OF PILOT INFLOW, FY 1980 THROUGH FY 1986

For all three of the flow categories across all the year groups, the flows are larger from 1981 through 1983 than after. The reason for this trend may differ by flow. For the *lateral ins* category, much of the flow is in the relatively inexperienced year groups at a stage in their careers where lateral transfers are more likely. The *accessions* category has relatively large numbers for the more experienced year groups. Because lateral transfers and recalls are policy variables, it appears that, after 1983, policy changes were made to reduce or eliminate these *accessions*. *Accessions* were completely cutoff in 1984 and then allowed to trickle in in 1985 and 1986. The absence of a large number of *accessions* is a major reason why there is less variation among the four continuation rates for the latter groups than the earlier ones. The *year-group ins* are a combination of two groups. The first group includes those who change year groups as a result of early or late promotions, and the second group includes those officers who had incorrect entries for year group in the Officer Master File. The large upsurge in *year-group ins* in 1983 (see figure 2) is more likely a result of recoding data in the Officer Master File than for changes resulting from the promotion system.

The relatively small number of inflows of various kinds in the last few years means that the variation in measured continuation rates is likely to be smaller today than it was five years ago. However, this does not mean that the issues discussed in this paper are no longer important. One reason they are important is that a historical comparison that does not account for the change in the level of turbulence portrays an inaccurate picture of changes over time. For example, the cumulative continuation rates for helicopter pilots were roughly the same in 1981 and 1985. In 1981, there were a significant number of *accessions*, and in 1985 there were only a few. Although the two years appear to be the same, continuation may be more of a problem in 1985 because of the lack of *accessions*. Thus, ignoring changes in the amount of turbulence makes historical comparisons difficult to interpret. A second reason the issues are relevant is that the lack of turbulence in recent years does not guarantee a lack of turbulence in future years. Many manpower trends and problems run in cycles; it is possible that at some future date the number of inflows will increase once again. Measures of continuation need to account for the changes in these flows.

CONCLUSIONS

This paper has examined a number of issues relating to the correct calculation of continuation rates. Planners use continuation rates to project future availability of manpower. Continuation rates are a measure of the fraction of a cohort that remain in an officer community from one year to the next. These rates are generally calculated by comparing the inventory of officers in a cohort at the beginning and ending of a period.

Although the concept of continuation rates is straightforward, this paper points out that both conceptual and data problems arise in determining these rates. Continuation rates measure the outflow of manpower from a community. Most communities, however, experience inflows as well as outflows—hence, the conceptual problems.. In this paper, these inflows (and other outflows due to data problems) are referred to as turbulence because they interrupt the smooth outflow of inventory anticipated in the definition of the continuation rate. The treatment of this turbulence has a significant effect on the continuation rate.

The analysis also revealed that by matching beginning and ending inventories, which is typically done to calculate continuation, an inconsistency in the treatment of inflows is introduced. In such calculations, newly inflowing officers are not included in the numerator in the year they enter the cohort but are included in the numerator in subsequent years. Using this technique leads to a consistent underestimation of actual continuation.

The most common data problem is the missing year group. When there is an error in the year-group field of the OMF, an officer could be excluded from either the beginning or ending inventory, and in some cases both. These exclusions result in an error in the calculation.

Because of turbulence in the data, pure continuation—that is, tracking an initial cohort over several years—cannot be accomplished by matching the beginning and ending inventories each year. A longitudinal file must be created that strings together the OMFs over the period under study.

These issues vary considerably in importance over time. The effects are strongest for year group 73. Depending on which definition is used, the range of cumulative continuation rates varied from the low 60s to the mid-80s. Total strength of year group 73 in 1986 is about 75 pilots higher than would be expected by applying annual continuation rates based on comparing beginning and ending inventories without regard to the inflows. The size of this difference is surprising considering that the inflows to the pilot community are probably smaller than the inflows into other communities. The magnitude of the data-related error appears to be smaller but also significant. The differences for later cohorts, such as year group 78, are considerably smaller.

Finally, the paper demonstrated that different definitions of the continuation rate are appropriate for different problems. When continuation is used as an indicator of total inventory, the inflows should be included in the calculations of the endstrength. However, when the continuation rate is needed to measure the response of attrition to policy changes, tracking initial inventories is a better measure of continuation.

APPENDIX A

DATA FOR PILOTS ONLY (131X)

APPENDIX A

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The analysis in the text used data that included officers with designators 131x, 139x, and 121x. Data for pilots only, that is, data for officers with designator 131x (a Line Officer qualified for duty involving flying as a pilot) are reported in this appendix. Figures A-1 through A-6 (which are analogous to figure 1 of the text) show the inflow and outflow for each year group 73 through 78. There is much greater turbulence for 131xs, particularly for the later year groups, because there are a lot of designator changes from 139x (officer in training for duty involving flying as a pilot) to 131x. In the main text, these changes are *intras*, but in these data they are treated as *lateral ins*.

Using the data on inflows and outflows in figures A-1 through A-6, the alternative continuation rates are reported in table A-1. The difference between the total stength and other definitions is much larger in the later years than those reported for all pilots (131x and 139x) because of the larger numbers of *lateral ins*.

TABLE A-1

ALTERNATIVE CONTINUATION RATES FOR PILOTS ONLY IN YEAR GROUPS 73 THROUGH 78

Year group	YOSs covered	Total strength	Gross w/o *YG outs*	Gross w *YG outs*	Original cohort
73	7-13	84.9	66.6	69.9	71.8
74	6-12	62.6	49.9	53.4	54.8
75	5-11	44.1	38.5	44.1	52.6
76	4-10	52.2	40.6	42.8	43.2
77	3-9	50.7	42.2	45.1	43.8
78	2-8	58.7	40.3	43.6	41.1

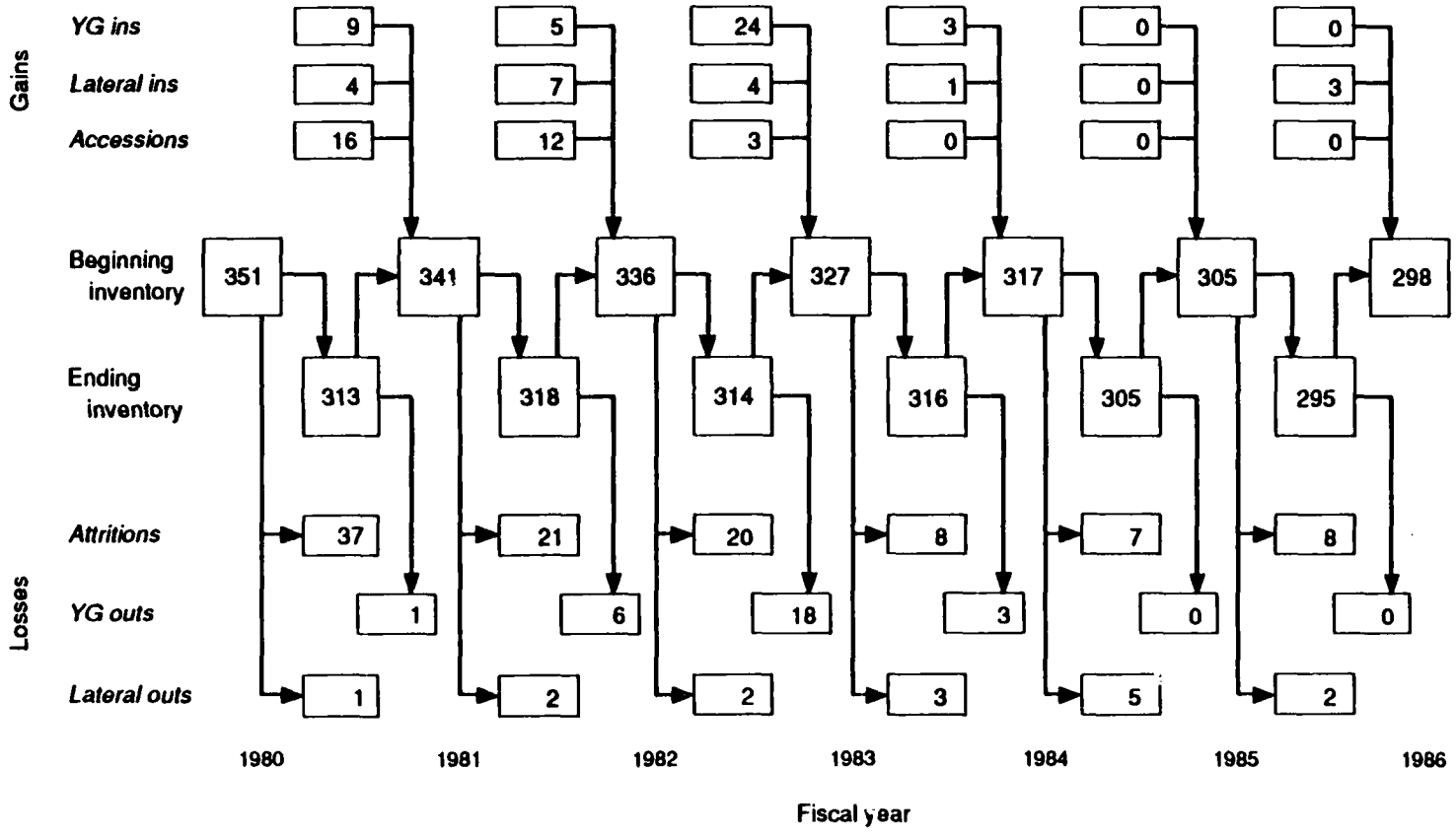

FIG. A-1: YEAR GROUP 73 PILOTS (131x ONLY), FY 1980 THROUGH FY 1986

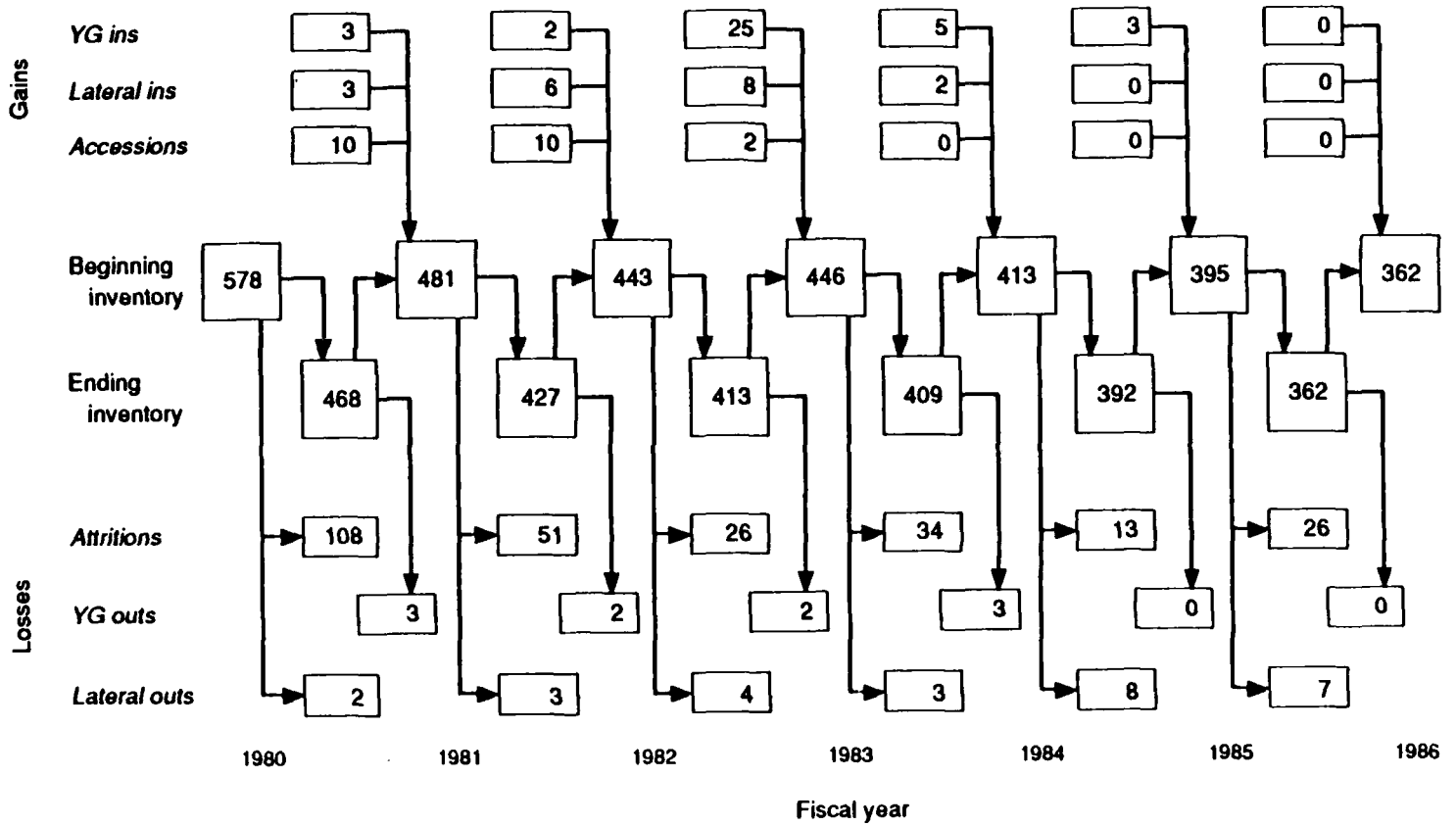

FIG. A-2: YEAR GROUP 74 PILOTS (131x ONLY), FY 1980 THROUGH FY 1986

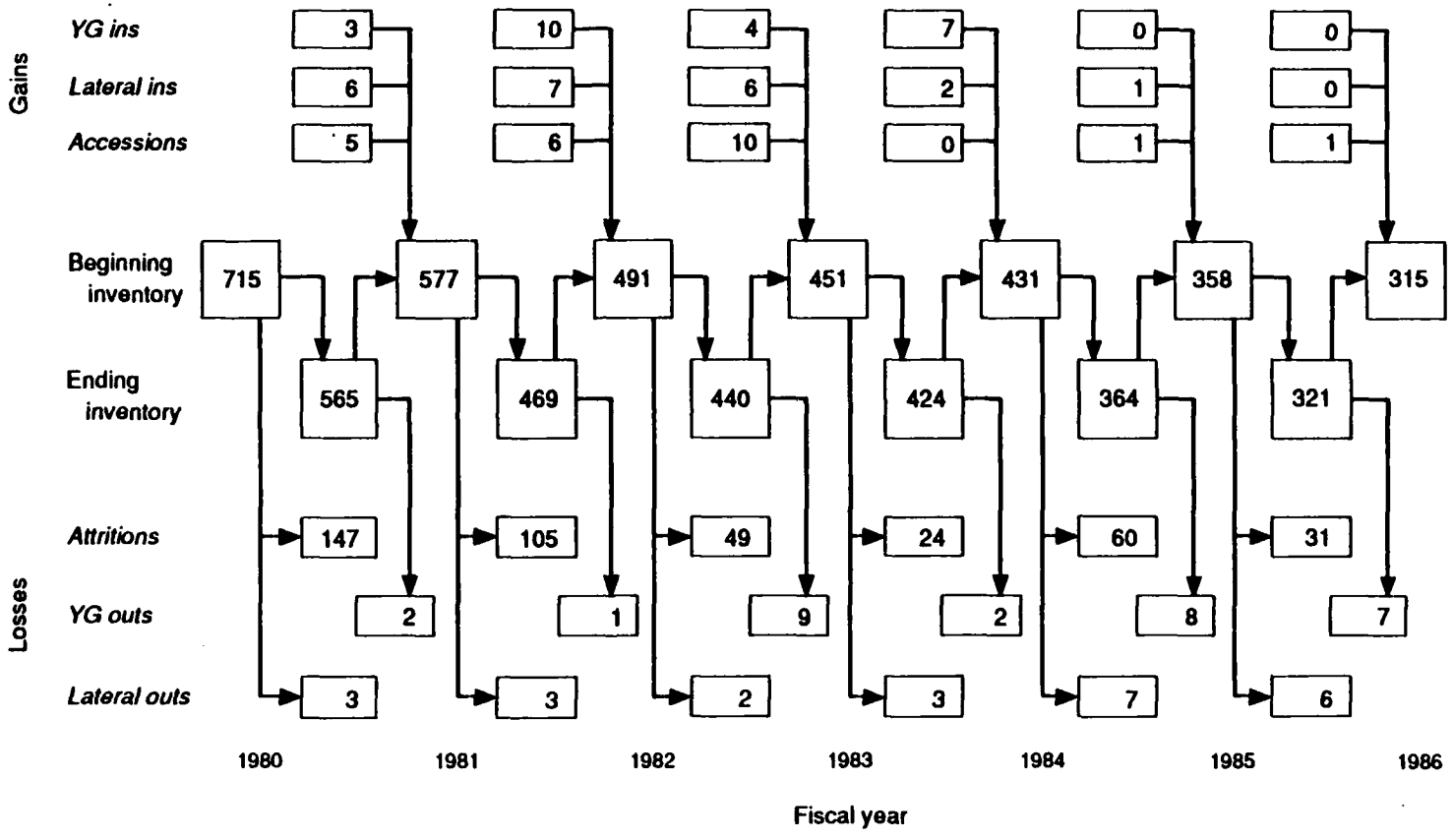

FIG. A-3: YEAR GROUP 75 PILOTS (131x ONLY), FY 1980 THROUGH FY 1986

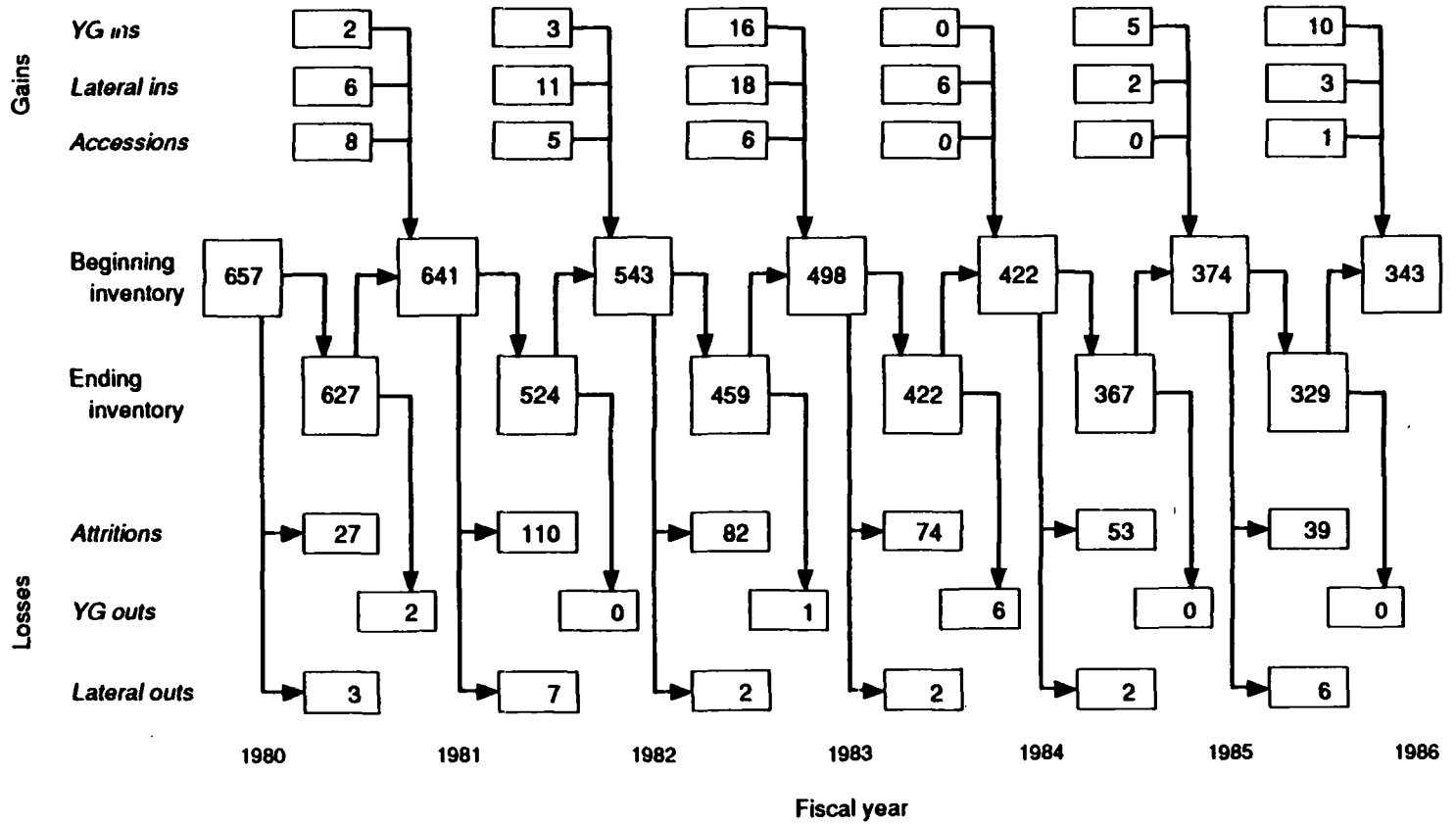

FIG. A-4: YEAR GROUP 76 PILOTS (131x ONLY), FY 1980 THROUGH FY 1986

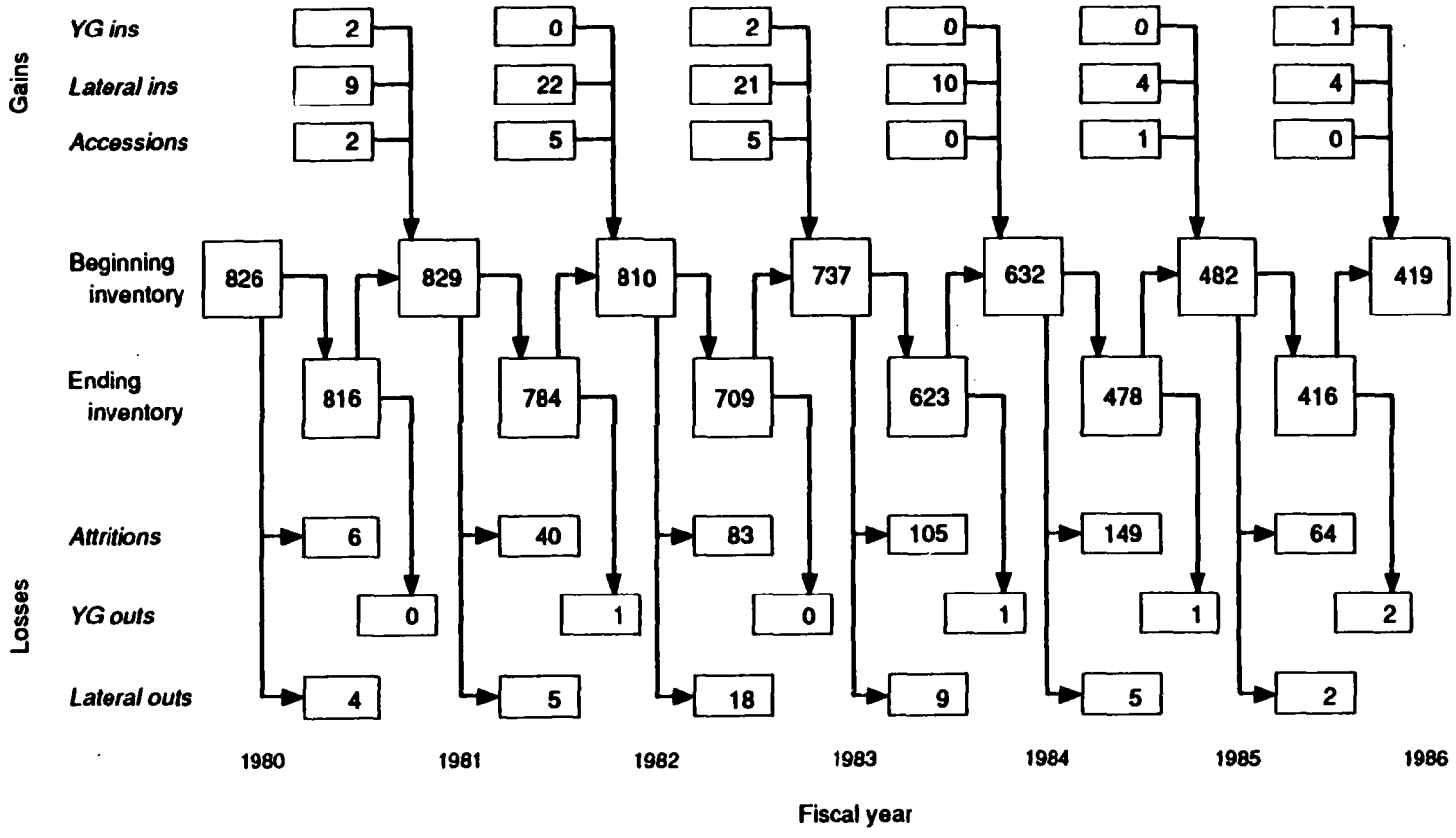

FIG. A-5: YEAR GROUP 77 PILOTS (131x ONLY), FY 1980 THROUGH FY 1986

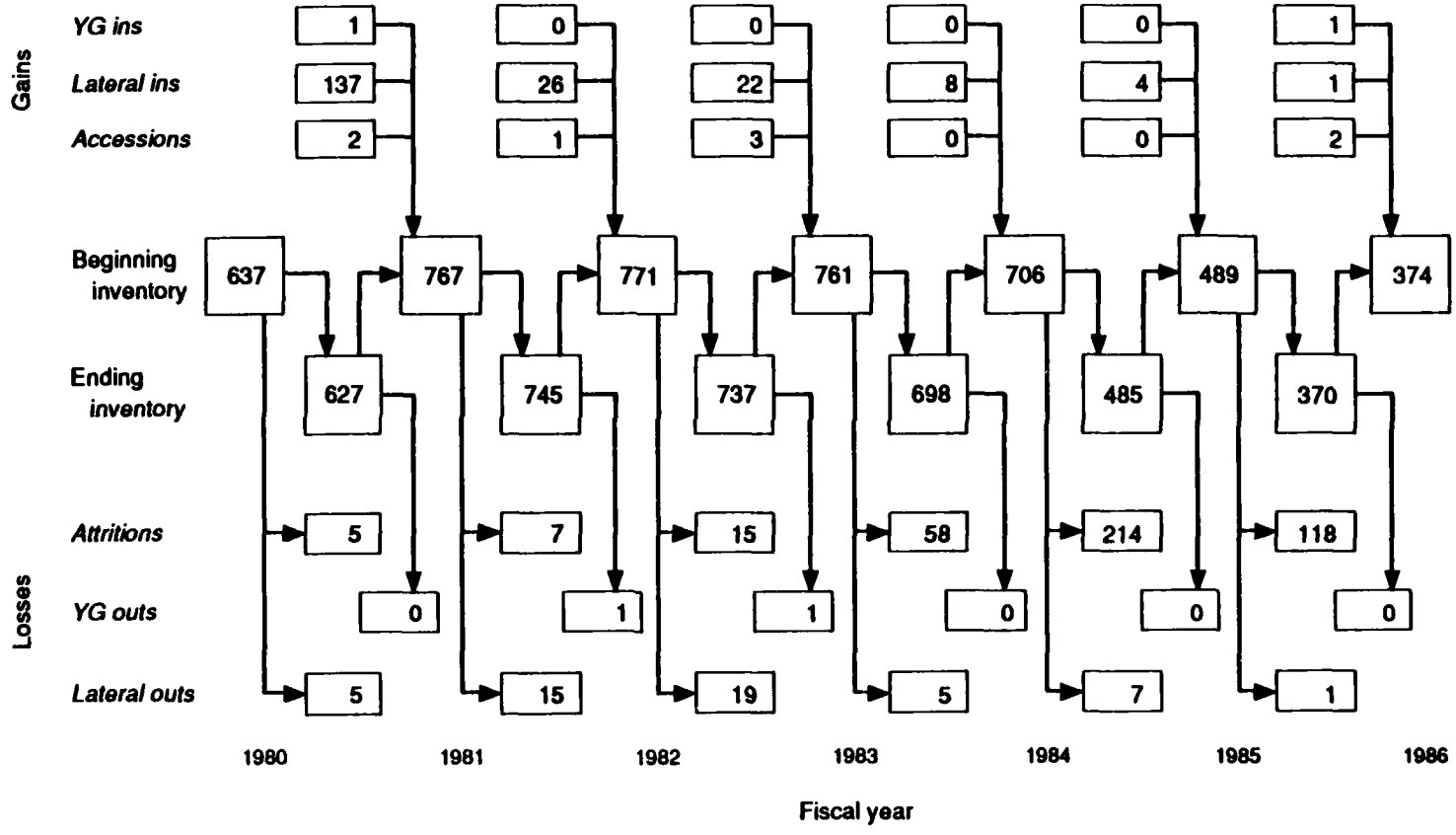

FIG. A-6: YEAR GROUP 78 PILOTS (131x ONLY), FY 1980 THROUGH FY 1986